dom as it was deemed safe. The first use that he made of his liberty was to build himself a platform on one of the trees that stood close to his habitation. One cloudy August morning, while seated on his arboreal perch, he noticed some early visitors open out their umbrellas to protect themselves from a passing shower of rain, and straightway he broke off a leafy branch and held it umbrella-fashion over his own head in immitation of the human folks!

It was amusing to see him following visitors who happened to have anything tied in their cloth, or who carried a bundle on their head. Quick to observe, he had noticed some of them untying a bundle to give him a feed, and by a simple process of ratiocination he came to connect all bundles with food and feeding!

Physiological economy of animals affected by accidents.

A Large White Egret (*Herodias alba*) having lived happily in the Garden for many years managed to break one of its legs by sustaining a fracture of its left tarsus. The fracture was set up and the wound healed nicely, but the shock of the accident must have materially affected the physiological economy of the bird's system; as during the next two years it did not assume the full breeding plumage, or the bright green of the facial skin which it usually did in summer and which was such a characteristic feature of the bird Although in about three years after the accident it began putting on the summer dress again, there was a marked deterioration in the character of the plumes and the colour of the facial skin. This might have been due to old age also.

IX.—*On the Variation of the Flower of* Ranunculus arvensis.—*By* I. H. Burkill, M.A.

There is a regular sequence of organs in the Phanerogamic flower,—sepals, petals, stamens, carpels,—which is never departed from, and which may be said to be due to the passing of moods over the axis,—a mood for the formation of sepals, a mood for the formation of petals, a mood for the formation of stamens, and a mood for the formation of carpels. Each mood is preclusive in its time of the others and definite; and the flower axis runs through them as a matter of course.

In the flower, mood follows mood very closely; yet the tendency so widely manifest, for the floral organs to be formed in whorls is a separating of the moods each from its neighbours by concentrating on itself.

The symmetry of the flower depends firstly on this regular sequence and separation of the moods; it depends secondly on the way in which successive rings of organs,—sepals, petals, etc.—are commonly isomerous.

I have been driven to a conviction that the separation of these moods has not yet obtained the attention it deserves. We need to know much about them; chiefly as to the conditions which lead to their separation: for the whole Phanerogamic subkingdom shows us that the more specialised a flower is the more distinctly are its moods separated; and the isolation of the moods is undeniably of far-reaching importance in the growth of perfect floral symmetry.

It may be said that there are questions of four kinds to be asked regarding the moods, (i) why the moods exist, (ii) as to the reason of their sequence, (iii) as to the requirements which have made them as distinct as they are, and (iv) as to the causes leading to a determination of the number of lateral organs which belong to each of them severally.

They are questions in organography, as Goebel terms the causative morphology of the new school, in order to distinguish it from the descriptive morphology which is subservient to the systematist. The foundation of organography is in the Darwinian theory of evolution.

The present paper concerns questions of the fourth kind; but in preface I wish to make some brief remarks regarding the second and the third kind of question. Regarding the second: the sepals are formed outermost to protect; the petals are formed second to attract; and we have these reasons for the position of both; but why the mood for the formation of stamens should invariably precede that for the formation of carpels is a question which must remain a subject for speculation almost as long as the origin of the Phanerogams is unsolved. This only can be said, that somehow the formation of female organs puts a period to the forward growth of the axis, whereas the forming stamens have divided with the axis the available nutrition passing beyond the growing sepals and petals. This perhaps means some advantage in the matter of food to one or the other. I do not say which: but it is to be confessed that there are strong reasons for assuming that, in nature generally, conditions of good nourishment tend more to the formation of female than of male organs: for experiments on the lower plants—Algæ, Fungi and Vascular Cryptogams—have shown that there is a tendency for female reproductive organs to be formed when the plants are well nourished, male organs when they are starved: and extensive observations on animals indicate the same thing. A condition so widely true may well be true also of the Phanerogams; but at the present time can we produce any convincing evidence that the developing bud

gets better nourished as it progresses from the formation of sterile protective or showy organs, through male organs to female organs, or that the female organs appropriate two shares of nutriment because there is by them that which might belong to an elongating axis ?

Regarding the third kind of question, let it be remarked that intermediate organs are apt to be useless organs and that therefore we see one reason for the distinctness of the moods; secondly, it is to be stated that if we let ourselves believe that sepals, petals, stamens and carpels are formed under conditions of nutrition which change as the axis gives rise to them, we still cannot easily assume that the conditions of nourishment change as abruptly as do the moods.

Lastly, with regard to the fourth kind of question we are bound to suppose that a certain relationship between the number of the stamens and carpels exists which is at least not prejudicial to the maintenance of the race; *i.e.*, that enough stamens must be produced to enable a sufficiency of seed to be set by the carpels; and it is reasonable to believe that the petals and the sepals are required by their biological functions to bear a more or less definite proportion to the organs they protect or make conspicuous: but it will be acknowledged that this supposition implies a force too loose in its action to produce isomerism as we see it, too loose to regulate the not uncommon orderly change of a normally tetramerous flower to pentamerism, or of a normally pentamerous flower to hexamerism, and impossible to accept as the sole factor when we glance at the general absence of intermediate conditions between isostemony and diplostemony. The view to which Schwendener's and Karl Schumann's work leads, can carry us a step beyond this supposition; for, as they have shown, we have strong reasons for believing that the symmetry of a flower is largely influenced by the mutual pressure in the bud of part on part, and that this pressure to a considerable degree compels new organs to appear in the niches between those recently formed. Thus do the sepals—the outermost members of the flower—as it were set the step and, *e.g.*, if they are in rings of five (I use the word ring because I require a term less definite than whorl) the petals and stamens frequently follow in fives.

The carpels too may follow the step, but their position is unique in that the axis is no longer growing forward when they form and new conditions of pressure, as perhaps of nutrition, are possibly existing.

The individual and the race are always in slight antagonism: the race asks for reproduction, and some writers such as Axell have thought that they could see in the flower the most perfect adaptation or subservience to reproduction. But our flower, above conceived,

asserts the individual distinctly if we allow the possible formation of sexual organs by order according to nutrition available, and the fixing of the number by the need of packing. I shall show later, at least in *Ranunculus arvensis*, another assertion of the individual—a setting aside of the claims of the race by allowing a kind of right of primogeniture to the moods in the flower. This right of primogeniture is the more interesting when we consider it in connection with the view that sepals and petals are sterilised stamens; for it gives preference to the mood which by origin is then supposed secondary.

The above remarks are to be taken as embodying some notion of the foundations of the Phanerogamic flower. Working upon them we may make a study of a particular species of plant in order to seek how far the fixed and definite relationships of the organs in number to one another, which we can observe in most Phanerogams, may be due to the compelling influence of pressure in the bud acting inwards from the outermost organs (sepals), or to the way in which nutrition becomes available in the developing axis, or to nutrition and the influence of pressure combined, or to the attempt of the plant to produce an effective and economical assemblage of reproductive members. I have proposed to approach the question by comparing the variation in adjacent sets of floral organs, and seeing how far in different types of flower any one set is free to deviate from pattern.

There are flowers where the jointing of set on set may be considered to be loose, where adjacent rings of organs are not isomerous and such flowers seemed best for my purpose. One such is *Parnassia palustris* where a 4-merous ovary tops an otherwise 5-merous flower; another is the garden Gloxinia where 2 carpels top a similarly 5-merous (potentially in stamens) flower. It is to be asked if, as a rule, variation from normal is more easily accomplished on the upper side of the badly fitting joint than elsewhere. If so, then the inference is obvious that pressure is playing a large part in keeping to type the moods of that flower which are well jointed.

This I found to be the case with *Parnassia palustris*. In 1894 and 1895 I examined over 5,000 flowers and I recorded my observations in the Journal of Botany, 1896, pp. 12–15.

I had approximately 5,152 flowers normal in the number of sepals and in only two of them did the petals, stamens and staminodes fail to keep true to symmetry; but the carpels diverged from the normal four in 450 cases. I had 36 flowers abnormal in the number of sepals, 15 with only four, 21 with six, and in all but three of those flowers petals, stamens and staminodes followed the lead and varied with the sepals; but in them eleven flowers had three carpels, nine had the usual

four, fourteen had five and two had six. So much for the free variation above the badly fitting line in Parnassia. In the garden Gloxinia on which I have made, when at Kew, some unpublished observations, it is the same. Gardeners have selected and raised beautiful races with more than the normal number of petals; the selection was never for the sepals or stamens, but these two sets of organs have varied hand in hand with the petals while the ovary which normally has two carpels hesitates in the improved race between two and three.

A table which I gave in my note on Parnassia shewed that when the sepals were 4, the carpels were generally 3; and when the sepals were 6, the carpels were generally 5. Herein we see a correlative increase or decrease in both. Now it is easier by $\frac{1}{30}$ of the unit to squeeze five than to expand three into the space of four and it happened in Parnassia, as I showed in a table on page 13 of the Journal, that five carpels were more common in 6-merous than three in the 4-merous flowers,—an observation in accord with ideas of pressure but of a ring on a confined area; and not of organs compelling others to fall into the niches between them. Towards satisfying myself in this matter, I devised a little machine for measuring divergences and succeeded in demonstrating (see *Annals of Botany*, XV, 1901, pp. 187-192) that, at least when near fruit-ripening, the carpels in Parnassia have no very exact relationship in position to the sepals.

After examining Parnassia I sought for a flower with worse fitting joints or better with no joints at all and took *Ranunculus arvensis* for my purpose.

Ranunculus arvensis is a little cornfield weed of Europe and Temperate Asia, an annual and easily grown. It is very variable in the flower and in all parts of it; it has not got that concentration of the moods for the formation of the various floral organs which occurs in all regularly whorled flowers, its moods for the formation of petals and stamens being particularly ill-defined. These irregularities seemed to me qualifications suiting it particularly to my purpose. The sepals are commonly 5 with a divergence of $\frac{2}{5}$, the petals are 5 or fewer alternating with the sepals and repeating their divergence; but the stamens and carpels have a completely different arrangement; the former are very variable in number and the latter generally 4–7.

I grew my plants in 1895 in the University Botanic Garden, Cambridge, from seed which had ripened in the Botanic Gardens of Bonn and Hiedelberg, Paris, Stockholm and Bordeaux, and in 1898 in a window box at Kew from seed which had ripened in the years 1896 and 1897 in the Royal Botanic Gardens, Kew. I made a point of examining every flower produced, counting and recording the

number of its sepals, petals, stamens and carpels, and noting any obvious abnormalities in it. For the purpose the flowers were picked when just open, and this picking, done daily, caused the plants to continue long in blossom.

In this way I examined in 1895, 1,383 flowers from Heidelberg seed and 1,203 from Bonn seed; in 1898, 2,298 from Kew 1896 seed (157 plants) and 1,589 from Kew 1897 seed (73 plants); and also in 1895 lesser numbers of flowers from Paris, Stockholm, and Bordeaux seed—numbers too small to be of real service. I give the results of the examination of the Paris, Stockholm and Bordeaux plants here before proceeding. I shall not mention them again.

	No. of flowers.	Average No. of Sepals.	Average No. of Petals.	Average No. of Stamens.	Average No. of Carpels.
Stockholm	135	4·94	4·49	8·27	5·87
Paris	382	4·91	3·50	5·50	5·25
Bordeaux	167	4·95	4·10	6·74	5·37

As to the more profitable experiments I found the different sowings to vary as follows :

Table I.—Variation in Sepals.

No. of Sepals.	0	1	2	3	4	5	6	7	8	9
Heidelberg	...	...	...	1	85	1,287	8	1	0	1
Bonn	...	1	0	9	69	1,121	2	0	1	...
Kew, Old	...	...	2	13	63	2,217	3	...	...	...
Kew, New	1	3	4	18	46	1,516	1	...	...	...

Table II.—Variation in Petals.

No. of Petals.	0	1	2	3	4	5	6	7	8
Heidelberg	...	5	126	486	417	345	3	1	...
Bonn	...	4	82	349	438	327	1	1	1
Kew, Old	2	2	26	237	430	1592	9	...	...
Kew, New	3	2	19	182	289	1091	3	...	...

Table III.—Variation in Stamens.

No. of Stamens.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Heidelberg ...	...	1	12	21	65	136	238	308	282	170	98	32	8	4	3	3	1	1	...
Bonn ...	...	.	1	4	9	21	81	154	247	294	211	123	36	8	5	6	0	2	1
Kew, Old ...	..	...	1	5	62	229	433	428	304	270	134	140	97	73	69	27	17	9	...
Kew, New ...	...	...	3	6	30	143	292	265	203	190	140	95	74	60	46	25	1	4	1

Table IV.—Variation in Carpels.

No. of Carpels.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Heidelberg ...	3	3	13	95	266	511	314	136	31	8	0	0	1	0	0	1	1
Bonn ...	5	10	4	35	155	426	379	153	28	6	2	...	...	...	...	...	...
Kew, Old ...	...	3	24	175	362	634	584	403	107	6	...	...	...	...	...	...	...
Kew, New ...	1	2	16	68	198	353	391	364	158	37	1	...	...	...	...	...	...

There is an obvious difference between the two German races and the Kew race and some difference between the Kew plants from 1896 seed and those from 1897 seed although they belonged to the same stock. The variation curves which may be plotted from these figures are irregular, and those for no one set of organs exactly correspond with those for neighbouring sets: the curves of the sepals are half-Galton curves: and the curves of the petals in the Kew race are also half-Galton curves, but not quite as those for the sepals; while the curves of the petals in the German races are intermediate between half-Galton and symmetric Quetelet binomial curves: the curves for the stamens are equally asymmetric, but in a different way; while the curves for the carpels are the most nearly bi-symmetric of all but are not quite so. It is evident from a comparison of them that the flower does not vary as an unit as for instance a Tulip flower may, every ring of organs changing from 3-merism to 4-merism; but each mood varies in its own manner. We shall learn more of this independence of the moods in variation by studying their association. I cannot give tables of the combinations observed in the different races for all the four sets of organs taken two together, without occupying a great amount of space; I therefore give tables for the "Kew Old" plants alone. They will serve as an illustration for all, as the tables which could be given for the German races and "Kew New" are not unlike them.

Table V.—Kew, Old—Correlation of Sepals and Petals.

Sepals.	0	1	2	3	4	5	6	Total No. of flowers.	Average No. of Sepals.
0 Petals ...	...	...	...	...	...	2	...	2	...
1 ...	...	...	...	...	...	2	...	2	...
2 ...	...	...	1	...	2	23	...	26	4·81
3 ...	...	...	...	7	24	205	1	237	4·85
4 ...	...	...	1	6	26	396	1	430	4·89
5 ...	...	...	...	...	10	1,582	...	1,592	4·99
6 ...	...	...	...	...	1	7	1	9	5·00
Total No. of flowers ...	...	...	2	13	63	2,217	3	2,298	...
Average No. of petals...	...	...	...	3·46	3·71	4·60	...	...	...

Table VI.—Kew, Old—Correlation of Sepals and Stamens.

Stamens.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total.	Average.
Sepals ..	...	...	...	...	...	...	...	...	...	...	.	...	...	...	..	...	...	...	...
2 ..	..	.	...	...	...	2	...		...	...	..	...	...	...	...	...		2	...
3 ...	...	...	..	4	4	2	2	1	...	..	...	...	...	.	...	...	.	13	4·39
4 ...	...	...	..	10	17	18	5	4	3	3	1	0	2	...	..	...	...	63	5·25
5 ...	...	1	5	48	208	410	419	299	267	131	139	97	71	69	27	17	9	2,217	7·01
6 ...	...	...	...	...	...	1	2	...	...	..	..	...	..	...	...	...	...	3	...
Total ..	1	5		62	229	433	428	304	270	134	140	97	73	69	27	17	9	2,298	...
Average ...	...	...		4·71	4·89	4·94	4·98	4·98	4·99	4·98	4·99	5·00	4·97	5	5	5	...	...	...

Table VII.—Kew, Old—Correlation of Sepals and Carpels.

Carpels.	0	1	2	3	4	5	6	7	8	9	10	Total.	Average.
Sepals ...	...	...	...	...	...	...	...	...	...	...	...	...	...
2 ...	...	...	...	...	2	...	...	...	...	...	...	2	...
3 ...	...	...	2	3	4	3	0	1	..	...	...	13	3·92
4 ..	...	1	2	21	20	10	6	3	...	...	..	63	4·05
5 ...	...	2	20	150	335	621	577	399	107	6	...	2,217	5·46
6 ...	...	...	...	1	1	0	1	...	...	...	...	3	...
Total ...	...	3	24	175	362	634	584	403	107	6	...	2,298	...
Average ...	...	...	4·75	4·84	4·93	4·97	4·99	4·99	5·00	...	...	...	...

Table VIII.—Kew, Old—Correlation of Petals and Stamens.

Stamens.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total.	Average.
Petals ...	..	..	...	...	...	...	...	...	...	...	...	...	...	...	..	.	...	...
0 ...	1	0	0	1	...	...	...	...	...	...	...	...	...	...	..		2	...
1 ...	...	..	1	0	0	0	1	...	...	...	...	...	...	...	..		2	...
2 ...	...	..	6	10	7	1	1	1	...	...	...	...	...	...	..		26	4·38
3 ...	...	3	24	88	48	35	32	4	3	...	...	...		...	..		237	4·91
4 ...		1	17	70	137	95	56	19	15	12	6	0	1	1	...	...	430	5·77
5 ...	...	1	14	59	237	295	212	246	116	128	91	73	68	26	17	9	1,592	7·91
6 ...	...		...	1	4	2	2	...	...	...	...	...	...	...	...		9	...
Total	1	5	62	229	433	428	304	270	134	140	97	73	69	27	17	9	2,298	...
Average	..	...	3·60	3·77	4·42	4·61	4·59	4·89	4·84	4·86	4·94	5·00	4·98	4·98	5	...	...	...

Table IX.—Kew, Old—Correlation of Petals and Carpels.

Petals.	1	2	3	4	5	6	7	8	9	Total.	Average.
Carpels	...	...	..	...	...	...	...	...	...	...	...
0	...	...	...	...	1	0	1	...	...	2	...
1	...	...	2	...	...	...	...	...	...	2	...
2	...	1	9	14	2	...	...	...	...	26	3·65
3	2	13	70	88	52	12	...	...	...	237	3·89
4	1	10	64	126	141	66	18	4	...	430	4·69
5	...	...	30	134	435	502	382	103	6	1,592	5·88
6	...	...	...	...	3	4	2	...	...	9	...
Total ..	3	24	175	362	634	584	403	107	6	2,298	...
Average	...	3·38	3·65	4·06	4·60	4·85	4·95	4·96	...	...	...

Table X.—Kew, Old—Correlation of Stamens and Carpels.

Stamens.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total.	Average.
0 Carpels ...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...
1 ...	...	...	...	2	...	1	...	....	...	...	...	...	...	...	...	...	...	3	...
2 ...	...	...	...	4	10	6	3	1	...	...	...	...	...	...	...	...	...	24	4·46
3 ...	...	...	3	26	54	60	19	11	2	...	...	...	...	...	...	...	...	175	4·61
4 ...	...	...	2	18	87	99	83	50	19	3	1	...	...	...	...	...	...	362	5·35
5 ...	...	1	...	7	55	175	67	104	80	24	15	5	1	...	...	...	...	634	6·18
6 ...	...	...	...	3	17	73	17	95	106	56	47	26	23	17	4	...	...	584	7·66
7 ...	...	...	...	1	6	17	116	39	55	48	58	52	35	36	12	5	3	403	9·44
8 ...	...	...	...	1	...	2	33	4	8	3	19	13	14	16	10	11	3	107	11·05
9 ...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	1	3	6	...
Total ...	...	1	5	62	229	433	428	304	270	134	140	97	73	69	27	17	9	2,298	...
Average ...	...	...	...	3·68	4·14	4·68	5·16	5·36	5·80	6·18	6·56	6·78	6·93	7·02	7·30	7·76	...	...	...

If we take three absolutely symmetrical dice and toss them the probable scores obtained in 240 throws mathematically calculated are as follows:—

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	3	6	10	15	21	28	36	36	28	21	15	10	6	3	1

If we take another three dice of distinguishing colour absolutely symmetrical, and throwing them with the others record the association of numbers, the resulting table will be as symmetric as the binomial curve just given, but in two dimensions, and out of 14,400 throws there is one chance of 3 + 3 being the score of the two sets of dice and one of 18 + 18, one of 3 + 18 and one of 18 + 3; there are three chances of the score being 4 + 3, and three of its being 17 + 3, *i.e*, equal chances as far as the extremes are concerned of there being a close similarity between the figures and a wide dissimilarity. A glance at the tables just given will satisfy that this is not the case in them and that the tendency to similarity is evident; that in the mutual relationship of mood to mood the adjustment is not a question of chance but, as is indicated by the averages in the last column and lowest line of each table, is due to some loosely coercing force which will be discussed.

As I have foregone the publishing of tables to give for the Kew New plants and the Bonn and Heidelberg races my exact observations on adjustment of moods, I place below the averages found omitting those derived from fewer flowers than ten.

I will briefly call attention to the chief points in the averages. Table XI shows that fewer sepals mean fewer of all other organs and it is to be noted that the reduction is greatest in the organs furthest away from the sepals. Table XII shows for the Kew race a considerable reduction of both stamens and carpels when the petals are reduced; it shows for the German races a much slighter reduction of carpels and an insignificant reduction of stamens. It shows further that reduction in the number of petals does not act as a reflex on the number of sepals in anything like the way in which reduction of sepals may be said to promote reduction of petals. Table XIII shows that with a reduction or increase of stamens the reduction or increase of the carpels is much greater than the reduction or increase of the organs which preceeded them. Table XIV shows that reduction or increase of carpels is accompanied by a more nearly corresponding reduction or increase in the organs closest to them. Consequently, admitting that there is an exception in the relation of petals to stamens in the German races, we may broadly state that the influence producing correlative increase or decrease chiefly acts forwards from the preceding mood to the moods which follow and that correlative increase and decrease is closest in neighbouring moods.

Table XI.—Average No. of other organs in association with three, four and five Sepals.

Number of Sepals.		3	4	5
Average No. of Petals ...	Kew, Old	3·46	3·71	4·60
	Kew, New	3·56	3·57	4·58
	Bonn	2·78	3·54	3·87
	Heidelberg	...	3·47	3·72
Average No. of Stamens...	Kew, Old	4·39	5·25	7·01
	Kew, New	4·73	5·37	7·42
	Bonn	3·78	7·31	7·83
	Heidelberg	...	6·28	7·27
Average No. of Carpels ...	Kew, Old	3·92	4·05	5·46
	Kew, New	3·67	4·09	5·94
	Bonn	2·11	4·79	5·48
	Heidelberg	...	4·31	5·19

Table XII.—Average No. of other organs in association with two, three, four, five and six Petals.

Number of Petals.		2	3	4	5	6
Average No. of Sepals ...	Kew, Old .	4·81	4·85	4·89	4·99	5·00
	Kew, New ..	4·58	4·76	4·87	4·98	.
	Bonn ...	4·83	4·91	4·92	4·98	...
	Heidelberg ...	4·93	4·95	4·89	4·99	...
Average No. of Stamens	Kew, Old ...	4·38	4·91	5·77	7·81	8·55
	Kew, New ...	4·47	4·97	6·00	8·12	...
	Bonn ...	7·84	7·68	7·68	7·98	...
	Heidelberg ...	7·17	7·20	7·18	7·35	...
Average No. of Carpels ...	Kew, Old ...	3·65	3·89	4·69		5·45
	Kew, New ..	3·37	4·21	5·12	6·36	...
	Bonn ...	4·94	5·18	5·45	5·82	...
	Heidelberg ...	4·74	4·82	5·25	5·63	...

Table XIII.—Average number of other organs in association with 2–16 *Stamens.*

Stamens.		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Average No. of Sepals...	Kew, Old ...	...	4·71	4·89	4·94	4·98	4·98	4·99	4·98	4·99	5·00	4·97	5·00	5·00	5·00	5·00
	Kew, New ...	...	4·77	4·67	4·92	4·95	4·97	4·98	4·98	4·99	5·00	5·00	5·02	5·00	5·00	...
	Bonn ...	...	4·33	4·86	4·87	4·91	4·93	4·97	4·93	4·95	5·03	5·00	...	...	...	...
	Heidelberg ...	4·83	4·86	4·81	4·88	4·94	4·95	4·98	4·92	4·97	4·97	5·00	...	...	...	...
Average No. of Petals ...	Kew, Old ...	...	3·60	3·77	4·42	4·61	4·59	4·89	4·84	4·86	4·94	5·00	4·98	4·98	5·00	5·00
	Kew, New ...	...	3·40	3·81	4·18	4·49	4·68	4·83	4·87	4·97	5·00	4·98	4·96	5·00	4·73	...
	Bonn ...	...	3·44	3·71	3·81	4·00	3·81	3·55	3·79	3·75	4·03	3·62	...	...	...	...
	Heidelberg ...	3·67	3·76	3·38	3·80	3·87	3·59	3·63	3·68	3·70	4·06	4·12	...	...	...	...
Average No. of Carpels	Kew, Old ...	...	3·68	4·14	4·68	5·16	5·36	5·80	6·18	6·56	6·78	6·93	7·02	7·30	7·76	7·00
	Kew, New ...	...	3·80	4·65	4·91	5·39	5·79	6·28	6·79	6·85	7·31	7·39	7·40	7·96	7·36	...
	Bonn ...	...	2·89	4·14	4·58	4·81	5·13	5·54	5·91	6·10	6·53	6·75	...	...	...	...
	Heidelberg ...	4·92	4·19	4·20	4·41	4·79	5·02	5·43	5·71	6·11	6·34	7·50	...	...	...	...

Table XIV.—Average number of other organs in association with 1–9 Carpels.

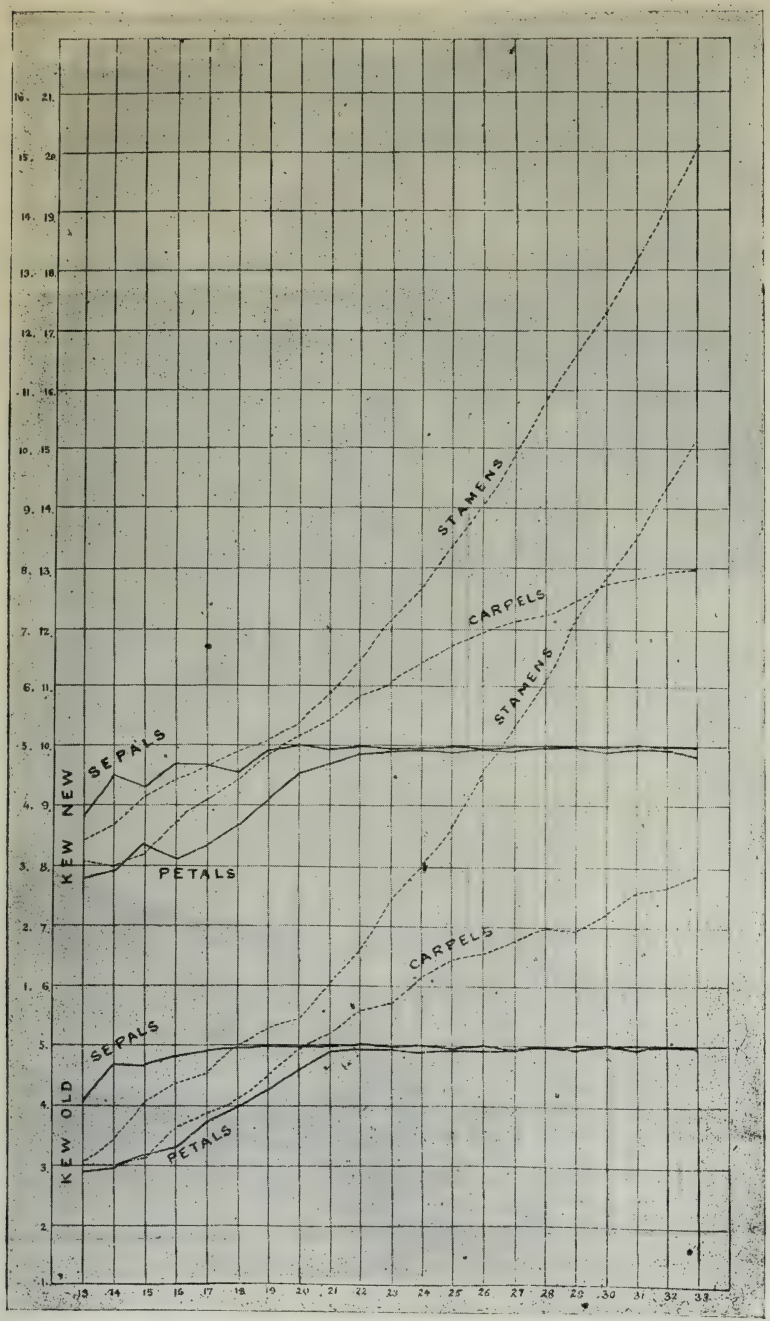
Carpels.		1	2	3	4	5	6	7	8	9
Average No. of Sepals	Kew, Old	...	4·75	4·84	4·93	4·97	4·99	4·99	5·00	...
	Kew, New	...	4·69	4·41	4·78	4·96	4·98	5·00	4·98	5·00
	Bonn	4·20	...	4·74	4·87	4·94	4·97	4·97	5·00	...
	Heidelberg	...	4·62	4·79	4·90	4·96	4·97	5·04	5·06	5·00
Average No. of Petals	Kew, Old	...	3·38	3·65	4·06	4·60	4·85	4·95	4·96	...
	Kew, New	...	3·31	3·18	3·77	4·51	4·73	4·88	4·91	4·95
	Bonn	3·66	...	3·60	3·52	3·74	3·94	4·11	4·36	...
	Heidelberg	...	3·44	3·18	3·43	3·58	4·03	4·19	4·09	4·12
Average No. of Stamens	Kew, Old	...	4·46	4·61	5·35	6·18	7·66	9·44	11·05	...
	Kew, New	...	3·94	4·63	5·22	5·98	7·16	8·87	10·27	10·68
	Bonn	4·90	...	6·03	6·72	7·28	8·26	9·18	9·57	...
	Heidelberg	...	5·50	5·84	6·37	7·11	7·84	8·50	8·90	8·50

I must now point out some differences between the races.

When one sepal less than the complete five is present in the Kew race there is approximately one petal less, two stamens less and $\frac{1}{2}$ carpel less: when two sepals are wanting then we lose further $\frac{1}{8}$ petal, $\frac{2}{3}$ stamen and $\frac{1}{4}$ carpel.

In the German races one sepal less than the complete five means roughly $\frac{1}{3}$ petal less, $\frac{3}{4}$ stamen and $\frac{2}{3}$ carpel: when two sepals are wanting we lose a further $\frac{3}{4}$ petal, $3\frac{1}{2}$ stamens, $2\frac{1}{2}$ carpels; *i.e.*, in the German races 4 sepaled flowers are more nearly otherwise normal than in the Kew race: and what is true for the sepals is true for the petals, *i.e.*, that the first reduction in them from normal is much more closely accompanied by a reduction in other organs than is the case in the two German races.

Apportionment of organs in the Kew race.—The least flower of the Kew race had 8 organs in all, the largest 36. The largest flowers were richest in stamens, the least richest in sepals. I give in table XV the average number of sepals, petals, stamens and carpels in flowers with varying numbers of total organs, and over leaf are curves expressing the result graphically. The result may be briefly stated thus:—if there is power to produce more than 15 organs the sepals claim their full compliment; if there is power to produce more than 20 organs, the petals also claim their full compliment; if there is power to produce more than 28 organs the carpels begin to show signs of



Graphic representation of the apportionment of sepals, petals, stamens and carpels in flowers of *Ranunculus arvensis* (Kew race) with the number of organs varying from 13 to 33.

satiety; extra power beyond this goes chiefly to the stamens. At 20 the flower is not far from having the formula K5 C5 A5 G5, *i.e.*, from being regularly 5-merous. The staminal curve shows slight irregularities at 15 and 18 the curves for petals and carpels practically touch at 15. The correspondence in the two sets of curves is most interesting.

Table XV.—Apportionment in flowers of the Kew race with the number of total organs varying from to 8 *to* 36.

No. of organs.	Kew, Old.					Kew, New.				
	No. of flowers.	Average No. of Sepals.	Average No. of Petals.	Average No. of Stamens	Average No. of Carpels.	No. of flowers.	Average No. of Sepals.	Average No. of Petals.	Average No. of Stamens.	Average No. of Carpels.
8 ...	...	...		...	...	1	0	3·00	1·00	4·00
9 ..	...	...	...	...	...	0	...	...	...	...
10 ...	...	...	...	...	...	1	2·00	3·00	4·00	1·00
11 ..	4	4·25	1·75	2·50	2·50	0	...	...	...	...
12 ...	2	4·00	3·00	3·50	1·50	5	3·40	3·00	3·40	2·20
13 ...	14	4·07	2 86	3·07	3·00	17	3·77	2·77	3 41	3 06
14 ..	32	4·72	2·91	3·41	2·97	20	4 50	2·85	3·70	2·95
15 ...	66	4·70	3·15	4·03	3·12	28	4 29	3·36	4·14	3·21
16 ...	80	4·81	3·26	4·34	3·59	55	4·71	3·18	4·42	3·69
17 ...	115	4·92	3·72	4·54	3·82	61	4·70	3·33	4·67	4·13
18 .	127	4·95	3·99	4·99	4·06	93	4 59	3·67	4·97	4 47
19 ...	173	4·98	4·26	5·27	4·49	81	4 98	4·12	5·07	4·83
20 ...	238	4·99	4·60	5·47	4·93	154	5·00	4·52	5·34	5·14
21 ...	256	4·98	4 82	6·00	5·21	146	4 98	4·72	5·83	5·47
22 ...	236	4·99	4·86	6·55	5·60	157	5·00	4·81	6·37	5·81
23 ...	188	4·99	4·96	7·32	5·72	127	4·98	4·87	7·13	6·02
24 ...	172	5·00	4·91	7·91	6·14	119	4·99	4 92	7·68	6·40
25 ...	128	4·99	4 93	8·63	6·45	109	5·00	4·90	8 38	6·72
26 ...	105	5·00	4·93	9·54	6·52	104	4 99	4 99	9·07	6 95
27 ...	84	4·99	4·98	10·29	6·75	76	5·00	4·96	9·84	7·20
28 ...	93	5·00	5·00	11·05	6·97	68	5·00	4·99	10 78	7·24
29 ...	64	5·00	4·99	12·09	6·92	48	5·00	5 00	11·54	7 45
30 ...	54	5·00	5·00	12·78	7·22	49	5·00	4 96	12·29	7 75
31 ..	29	5·00	4·97	13·45	7·58	42	5·02	4 98	13·21	7·79
32 ...	14	5·00	5·00	14·36	7·64	16	5·00	4 94	14·12	7·94
33 ...	15	5·00	5·00	15·13	7·87	7	5·00	4·86	15·14	8·00
34 ...	4	5·00	5·00	15·75	8·25	3	4·67	4·67	16·33	8·33
35 ...	3	5·00	5·00	16·00	9·00	1	5·00	5·00	16·00	9·00
36 ...	...	...	...	...	...	1	5·00	5·00	16·00	10·00

Table XVI.—Apportionment in flowers of the German races with the number of total organs varying from 4 to 47.

No. of organs.	Bonn.					Heidelberg.				
	No. of flowers.	Sepals.	Petals.	Stamens.	Carpels.	No. of flowers.	Sepals.	Petals.	Stamens.	Carpels.
4 ...	1	1·00	1·00	1·00	1·00	...	...	...	...	...
5-7 ...	0	...	...	...	...	...	...	...	...	...
8 ...	2	3·00	2·50	2·50	0	...	...	...	...	...
9 ...	1	3·00	3·00	2·00	1·00	...	...	...	...	...
10 ...	2	3·50	2·00	4 00	0·5	...	...	...	...	...
11 ...	2	5·00	3·00	2 50	0 5	1	3·00	4·00	1 00	3·00
12 ...	0	...	..	...	...	3	4·00	2·66	3·66	1·66
13 ...	3	3·66	2·67	3 33	3·33	4	4·50	2·75	2·75	3·00
14 ...	4	4·00	3·00	4·25	2·75	12	4·58	2·50	3·50	3·42
15 ...	7	4·14	3·14	5·00	2·71	23	4·87	3·09	3·96	3·09
16 ...	15	4·60	3·13	5·07	3·20	45	4·73	3·00	4·51	3·75
17 ...	37	4·90	3·22	5·00	3·89	73	4·79	3·34	5·18	3·68
18 ...	44	4·73	3 44	5·75	4·09	97	4·87	3 30	5·72	4·11
19 ...	88	4·98	3·29	6·21	4·52	162	4·97	3·33	6·27	4·43
20 ...	153	4·92	3·55	6·73	4·78	174	4·97	3·44	6·75	4·84
21 ...	157	4·94	3·74	7·23	5·09	221	4·99	3·69	7·13	5·19
22 ...	173	4·97	3 80	7·80	5·42	155	4·96	3·77	7·85	5·43
23 ...	162	4·98	3·96	8·34	5·73	132	4 96	4·05	8·20	5·79
24 ...	150	4·96	4·12	8·80	6·12	112	4·99	4·33	8·60	6·08
25 ...	88	5·00	4 35	9·09	6 56	69	5·02	4·39	9·18	6·42
26 ...	47	5·00	4 40	9·81	6·77	46	5·04	4·22	9·91	6·83
27 ...	34	5·00	4·71	10·28	7·00	27	5·00	4·55	10·15	7·30
28 ...	13	5·08	4·69	10·77	7·46	10	5·10	4·70	10·50	7·70
29 ...	9	4·89	4·67	12·11	7·33	5	5·40	5·40	11·60	6 60
30 ...	1	5·00	5·00	11 00	9 00	4	4·75	5·00	11·50	8·75
31 ...	4	5·00	5·00	13·50	7·50	2	5·00	5·00	14·50	6·80
32 ...	2	5·00	5·00	14·00	8·00	1	5·00	5·00	15·00	7·00
33 ...	1	5·00	5·00	14·00	9·00	1	5·00	5·00	16·00	7·00
34 ...	1	5·00	5·00	17·00	7·00	1	5·00	4·00	10·00	15·00
35 ...	1	5·00	5·00	16·00	9·00	0	...	...	...	...
36 ...	0	...	...	...	...	1	9·00	5·00	15·00	7·00
37-40 ...	0	...	...	...	...	0	...	...	...	...
41 ...	1	8·00	7·00	16·00	10·00	0	...	...	...	...
42-46 ...	...	...	...	...	...	0		...	...	...
47 ...	...	...	...	...	...	1	7·00	7·00	17·00	16·00

Apportionment in the German races.—I give in table XVI the figures for the German races. As in the Kew race so here, in poor flowers the sepals are most numerous and in rich flowers the stamens are most numerous. But in these German races the petals do not claim their full number until the flower is rich enough to have 29 or 30 organs and on the part of the carpels no tendency to be satisfied can be detected.

Mathematical expression of the curves in formulæ seems to be by no means impossible although they are complicated.

There is no fiat which says "this will be a flower of *Ranunculus arvensis*, the organs may vary in number a little from the ideal." But the fiat says "this will be a flower and must run throughout all its moods. So long as all are present let them jostle for their compliment." So they jostle and the older win as far as they may by being already established at the time when the younger begin to compete; the sepals take what they want only being forbidden from getting the whole five when that would leave too little for the other moods; and the petals following claim their portion in the same way but a little less strongly. There is left a residue for the stamens and carpels, and the larger it is, the more organs do the moods of both sets, but especially the stamens, obtain.

Nutrition.—If seeding be prevented, *Ranunculus arvensis* dies flowering in utter depletion. Therefore I could get from this little proletarian flowers formed under the best conditions and under the worst possible conditions of nutrition, and so seek the effect of starvation on the moods spoken of. My earlier paper (*Journ. Linn. Soc., Botany*, Vol. XXXI, p. 235) contained a note on this plant to show that in it, as in several other plants, the first formed flowers are richest in stamens and carpels; I can now give fuller statistics, and shall show distinctly that the flower is pauperised with the ageing of the plant. I have divided the flowering period of the plants grown in 1895 into three periods and of those grown in 1898 into four periods. The decrease with age in the number of parts in the flower is shown by the following averages:—

Table XVII.—Kew, Old. Average number of organs in flowers at different periods.

	Period 1. 6th July to 17th July.	Period 2. 18th July to 29th July.	Period 3. 30th July to 10th August.	Period 4. 11th August to 23rd August.
Sepals	4·99	4·98	4·99	4·89
Petals	4·95	4·85	4·66	3·95
Stamens	11·58	7·81	6·17	4·93
Carpels	6·78	5·97	5·28	4·15

Table XVIII.—Kew, New. Average number of organs in flowers at different periods; periods as in Table XVII.

	Period 1. 6th July to 17th July.	Period 2. 18th July to 29th July.	Period 3. 30th July to 10th August.	Period 4. 11th August to 23rd August.
Sepals	4·99	4·99	5·00	4·77
Petals	4·97	4·84	4·67	3·81
Stamens	11·63	7·95	6·14	5·07
Carpels	7·22	6·51	5·74	4·36

Table XIX.—Bonn. Average number of organs in flowers at different periods.

	Period 1. June 6th to July 10th.	Period 2. July 11th to August 29th.	Period 3. August 30th to middle of September.
Sepals	4·96	4·92	4·98
Petals	4·22	3·43	3·69
Stamens	8·80	7·74	6·85
Carpels	5·71	5·58	4·75

Table XX.—Heidelberg. Average number of organs in flowers at different periods; periods as in Table XIX.

	Period 1. June 6th to July 10th.	Period 2. July 11th to August 29th	Period 3. August 30th to middle of September.
Sepals	5·00	4·94	4·98
Petals	3·92	3·70	3·49
Stamens	8·24	6·99	7·07
Carpels	5·21	5·16	5·01

With this reduction in number of parts there is a reduction in the size of the flower and there is also a loss of fertility in the anthers. This loss of fertility is shown in the following tables.

Table XXI.—Staminodes in Kew plants at different periods; the periods the same as in Tables XVII and XVIII.

		Period 1. 6th July to 17th July.	Period 2. 18th July to 29th July.	Period 3. 30th July to 10th August.	Period 4. 11th August to 23rd August.
Kew, Old	Total number	91	1360	1572	1777
	Percentage of stamens reduced ...	2·58	21·31	47·49	56·48
	Average per flower ...	0·30	1·66	2·91	2·78
Kew, New	Total number	23	1072	1534	1178
	Percentage of stamens reduced ...	0·78	25·88	64·73	54·09
	Average per flower ...	0·09	2·06	3·98	2·74

Table XXII.—Staminodes in the German races at different periods; periods as in Tables XIX and XX.

		Period 1. June 6th to July 10th.	Period 2. July 11th to August 29th.	Period 3. August 30th to mid-September.
Bonn ...	Total number ...	24	82	33
	Percentage of stamens reduced ...	2·04	1·13	4·01
	Average per flower ...	0·18	0·09	0·27
Heidelberg ...	Total number ..	37	75	36
	Percentage of stamens reduced ...	1·86	1·13	2·61
	Average per flower ...	0·15	0·08	0·19

I think it will be conceded that poverty of organs and sterility of stamens are alike marks of the plants becoming worn out.

Different organs are unequally reduced in numbers, the stamens most of all and before the others. Tables XVII to XX show how the different organs are differently affected by the reduction: but to make this quite evident the following tables are given :—

Table XXIII.—Rate of reduction of organs in the Kew plants from period to period; periods as before.

		Periods 1 to 2	Periods 2 to 3.	Periods 3 to 4.
Kew, Old	Sepals	Practically *nil.*		0·10
	Petals	0·10	0·19	0·71
	Stamens	3·17	1·64	1·24
	Carpels	0·81	0·69	1·13
Kew, New	Sepals	Practically *nil.*		0·23
	Petals	0·13	0·17	0·86
	Stamens	3·68	1·81	1·07
	Carpels	0·71	0·77	1·38

Table XXIV.—Rate of reduction of organs in the German races from period to period; periods as before.

		Periods 1 to 2.	Periods 2 to 3.
Bonn	Sepals	Practically *nil.*	*Very small increase*
	Petals	0·79	*slight increase*
	Stamens	1·06	0·89
	Carpels	0·13	0·83
Heidelberg	Sepals	0·06	*increase of* 0·04
	Petals	0·22	0·21
	Stamens	1·20	*increase of* 0·08
	Carpels	0·05	0·15

It is easily seen that at the beginning of the flowering period a large reduction is made in the male organs; but that the reduction in other organs is chiefly at the end. The following table shows this excess of masculinity, which occurs at the beginning of the flowering period and is soon done away with after flowering has commenced.

Table XXV.—The percentage which the Stamens (fertile and infertile) make out the total of organs in the flowers, at different periods; periods as before.

	First period.	2nd period.	3rd period.	last period.
Kew, Old	68·52	56·68	53·89	54·29
Kew, New	61·16	54·98	51·68	53·77
Bonn	60·68	58·11		53·76
Heidelberg	61·13	60·93		58·55

It is impossible to dissociate the lack of nutrition felt, it must be believed, by the flowers of the worn out plants and the right of primogeniture spoken of. The power to satisfy the sepaline mood and the petaline mood and to form abundant stamens and carpels is in the nutrition of the flower.

On page 110, it was said that the moods jostle for their compliment of organs and that the older win by being already established when the younger begin to compete. There is a reservation to make in regard to this statement, to demonstrate which table XV has been recast in table XXVI. The latter table shows that in well and fairly well fed flowers — say with 20 organs and more—the proportion falling to the carpellary mood is nearly constant, and that, as already made more or less evident, the staminal mood is residuary legatee for the extra vigour. Therefore for the richer flowers the vigour may be said to be roughly apportioned between on the one hand the sepaline, petaline and staminal moods which three jostle each other, and on the other hand the carpellary mood. In flowers poorer in organs than 20, the carpellary mood seems less prepared for and is subject in like degree to the staminal mood to the jostling for space.

Thus do the richer flowers appear more pre-apportioned than the poorer ones and therefore more knit together into an unit in the direction in which the flowers of most Phanerogams are knit together. We may easily believe that, given a flower with its moods so knit together that they vary together, the force of pressure of organ on organ in the bud may finish the shaping of the whole.

We can see that the flowers of the Kew race are a little more knitted into an unit than those of the German races. Thus the petals and sepals are much more often equal in number, and (as is shown on p. 103) when we get a flower of the Kew race departing in the sepals from normal by losing one, then the other organs are more likely to lose in proportion than in the German races. In short there is more see-sawing of mood on mood in the German races than in the Kew race.

However there are irregularities in the curves with which I have been dealing which cannot clearly be attributed to the struggling of the moods for satiety and their relative advantages from primogeniture. These are made obvious in the recast table XV which we now have in XXVI.

The chief irregularities of the Kew race are :—

(i)—Between 15 and 20 the stamens are above what would seem reasonable, rather more so at 15, 16, 18 and 19 than at 17 and 20.

(ii)—At 23 the stamens are a little above what would seem reasonable, the carpels below.

I do not intend to attempt any explanation of these facts, but I must observe that if we cut out of our figures all flowers which have both their sepals and their petals other than five in number, the irregularities just noted almost disappear: and they do not disappear if we cut out only those flowers with sepals other than five: and this indicates that between 15 and 20 the stamens are able to add to their number from the petals. This is done in table XXVII.

Table XXVI.—Percentages of organs in the Kew race falling to the different moods in flowers of various numbers of parts.

No. of Organs.	Kew, Old.				Kew, New.			
	Sepals.	Petals.	Stamens.	Carpels.	Sepals.	Petals.	Stamens.	Carpels.
8 ...	...	...	...	...	...	37·50	12·50	50·00
9 ...	...	...	...	...	...	...	...	...
10 ...	...	...	...	...	20·00	30·00	40·00	10·00
11 ...	38·64	15·91	22·73	22·73	...	...	...	...
12 .	33·33	25·00	29·17	12·50	28·33	25·00	28·33	18·33
13 ..	31·32	21·98	23·62	23·08	28·96	21·26	26·24	23·53
14 ...	33·70	20·76	24·33	21·20	32·14	20·36	26·43	21·07
15 ..	31·31	21·01	26·87	20·80	28·57	22·38	27·62	21·43
16 ..	30·08	20·39	27·11	22·42	29·43	19·88	27·61	23·07
17 ...	28·95	21·89	26·70	22·45	28·64	19·57	27·48	24·30
18 ..	27·51	22·18	27·73	22·57	27·18	20·37	27·59	24·85
19 ...	26·22	22·42	27·72	23·63	26·19	21·70	26·70	25·40
20 ...	24·96	23·00	27·36	24·66	25·00	22·59	26·72	25·68
21 ...	23·73	22·93	28·53	24·79	23·74	22·47	27·75	26·02
22 ...	22·69	22·08	29·78	25·46	22·72	21·89	28·95	26·45
23 ...	21·72	21·58	31·85	24·86	21·64	21·15	31·02	26·19
24 ..	20·83	20·61	32·97	25·58	20·79	20·52	32·00	26·68
25 ...	19·96	19·71	34·53	25·78	20·00	19·59	33·50	26·89
26 ...	19·23	18·97	36·70	25·09	19·19	19·19	34·87	26·76
27 ..	18·47	18·43	38·09	25·00	18·52	18·37	36·45	26·65
28 ..	17·81	17·81	39·47	24·88	17·85	17·80	38·49	25·84
29 ...	17·24	17·18	41·70	23·87	17·24	17·24	39·79	25·72
30 ...	16·66	16·66	42·59	24·07	16·66	16·53	40·95	25·85
31 ...	16·13	16·01	43·39	24·47	16·20	16·05	42·62	25·11
32 ...	15·63	15·63	44·86	23·88	15·62	15·43	44·14	24·80
33	15·16	15·16	45·87	23·84	15·15	14·72	45·89	24·24
34 ...	14·70	14·70	46·32	24·26	13·73	13·73	48·04	24·51
35 ...	14·28	14·28	45·71	25·71	14·29	14·29	45·71	25·71
36 ...	...	...	...	...	13·89	13·89	44·44	27·77

Table XXVII.—Percentage of stamens present in flowers with sepals and petals any number, with sepals 5 and petals any number, and with both sepals and petals 5.

Total organs.		14	15	16	17	18	19	20	21	22	23	24
Kew, Old	All flowers ...	24·33	26·87	27·11	26·70	27·73	27·72	27·36	28·53	29·78	31·85	32·97
	Flowers with K5 ...	24·41	25·72	26·68	26·56	27·65	27·68	27·29	28·38	29·72	31·84	32·99
	Flowers with K5 C5 ..	...	13·33	25·00	21·27	23·61	24·54	25·66	27·76	29·22	31·36	36·62
Kew, New	All flowers ...	26·43	27·62	27·61	27·48	27·59	26·70	26·72	27·75	28·95	31·02	32·00
	Flowers with K5 ...	25·60	25·34	26·64	27·10	27·27	26·65	26·72	27·61	28·95	30·93	31·92
	Flowers with K5 C5 ..	...	...	...	14·71	22·22	23·80	25·16	26·57	28·44	30·43	31·44

Now it comes about from this tendency of stamens to gain below 20 in percentage at the expense of the petals, and from the tendency of the carpels above 20 to show satiety, that the excess of stamens over carpels is likely to be least at 20 and greater both above and below that number. Thus is the sex-proportion continually shifting along our curves.

Half staminodal petals were found in flowers of the Kew race as follows; it will be noticed that towards the end of the flowering period they appeared but one at a time in the flowers.

Table XXVIII.—Half Staminodal petals.

		Period 1	2	3	4
Kew, Old	Number	7	30	20	19
	In flowers	3	23	18	19
	Percentage	·47	·76	·79	·75
Kew, New	Number	9	16	11	14
	In flowers	5	·63	11	14
	Percentage	·72	·63	·61	·85

Lastly I have an abnormality to notice; it consists of a lobing of the petals, one lobe being larger than the other. I found this abnormality in the Kew race to be fairly frequent and further I found it to be most abundant when the number of staminodes was highest.

Table XXIX.—Lobed petals.

		Period 1	2	3	4
Kew, Old	Number	10	30	21	19
	In flowers	2	17	16	9
	Percentage	·605	·756	·839	·753
Kew, New	Number	5	17	13	7
	In flowers	3	16	12	6
	Percentage	·399	·674	·721	·427

Summary.

I have shown first of all (Tables I–IV) how the flowers of *Ranunculus arvensis* in the races studied, vary; and how each set of organs varies in a different way; so that the curves which may be plotted for sepals, for petals, for stamens, and for carpels are unlike, most of them neither perfect Quetelet-Galton nor perfect half Galton curves.

I have shown secondly (Tables V–XIV) that a correlative increase and decrease occurs between the different sets of organs; so that when the stamens or any other set of organs depart from normal, it is probable that all other sets of organs will depart from normal, but chiefly those which follow. This is important as it indicates a division of vigour among the various sets, to be distinguished from an increase of the one at the expense of another.

In Tables XV–XVI and in the graphic representation of them on page 106 I have followed this up by showing how if we take the total number of organs in the flower as a measure of the vigour in the bud, we find that the ring of sepals, being the first-formed of the sets of organs, has the first pull on the vigour and is most likely to get a full complement, the ring of the petals being the next in order, is the next to be satisfied, and that stamens and carpels obtain the surplus the stamens chiefly so. I consider that the curves might with some little trouble be translated into formulae by a mathematician.

In Tables XVII–XX, I show that the power to produce organs diminishes as the plant grows weaker towards its death. Sometimes a slight recovery occurred at the very end: I do not feel justified in suggesting a cause for it. In Tables XXI and XXII, I show that sterility of the stamens increases towards the death of the plant.

In Tables XXIII–XXV, I show that the stamens—the organs which profit chiefly as we have seen by the extreme of vigour—lose by its loss; and consequently the flowers are most male when blossoming begins.

In Table XXVI, I have represented Table XV in a different way, so as to bring out sharply the division of vigour (*i.e.*, number of organs) between the different sets (moods). I can show by it that the flowers with more than 20 organs, there apparently is a setting aside *ab initio* of so much vigour for the carpellary mood, the staminal mood becoming residuary legatee; while in flowers with fewer than 20 organs the carpellary mood has to jostle with the preceding ones for its place. I show also by it and by the Table which follows it (XXVII), that there are certain irregularities which seem to be due to a borrowing of organs by the staminal set from the petals, which

borrowing as may be noticed in Table XII, (see p. 102) probably is a more common occurrence in the German races than in the Kew race.

The last two Tables (Nos. XXVIII and XXIX) show the relative abundance of abnormal petals and staminodal petals at different times in the plants flowering.

The net result of the investigation is that we have in *Ranunculus arvensis* just a little of what (for want of a better term) may be called foresight in the formation of the flower. We find the flower completed however scanty the nutrition for it may be; and, when the nutrition is adequate, provision is, it seems, made in good time for the carpellary mood. The next problem will be to show how far in such a flower as that of Parnassia or of any Phanerogam, the constancy of the carpels is due to provision made for them when the bud first begins to be formed. Can the sepaline mood lead the carpellary by the nose, or is the carpellary not too important to the race to be without an assertiveness of its own?

It is interesting to observe that the staminal mood forms a sort of residuary legatee to the three early moods of the flower; interesting because we not uncommonly find that mood to disappear under conditions which have generally been ascribed to something disadvantageous to the plant (see Willis, On Gynodiœcism, 3rd paper, *Proc. Cambridge Phil. Soc.*, viii., 1893, p. 129).

We have sought in passing for any indication in the flower which might suggest that pressure of organ on organ exercises an influence in shaping the flower; and we found that flowers of 20 organs did come near to having the formula $K_5C_5A_5G_5$: and in Table V we saw K_4C_4 and K_3C_3 to be commoner combinations than $K_4C_{3\text{ or }5}$ (especially 5) and K_3 C_4 or indeed any other number, and in Tables VI and VIII ten stamens to be commoner than nine or eleven in association with five sepals or with five petals. These observations do not suffice for building up any very definite statement.

It is equally advisable at present from these tabulations to make no statement regarding the possibility of female organs demanding per unit for their inception more nutriment than male organs.

One notices in regard to the variation of the flower of *Ranunculus arvensis* that it is always hungry, *i.e.*, always capable to taking in more organs; the hungriest of its moods is that for the formation of stamens, next that for the formation of carpels, thirdly that for petals and least hungry that for sepals.

Just as we find sepals to tend to be constant in number throughout our larger groups such as the Dicotyledons and Monocotyledons; petals to be constant in number in lesser groups; carpels to serve by their

constancy for the defining of orders, and stamens to be by number the least serviceable in the making of a classification of Phanerogams, so do we find sepals to have the greatest tendency to be constant in *Ranunculus arvensis*, petals next so, carpels in the third place and stamens last, *i e.*, what we see in a broad view of the whole Phanerogamic Sub-Kingdom, we see again in the variation of the flower of this little weed.

I had intended to deal with variation in *Nigella sativa* and *Delphinium Ajacis*, when writing on *Ranunculus arvensis* but my facts, are insufficient. They may, however, be said to be indicative of a reduction in number of all parts with age. For the present I withhold them.

My thanks are cordially given to the Cambridge Botanic Garden Syndicate for the facilities afforded to me in the University Garden, and to all who have helped me. The tedious operation of casting my figures into tables has in Calcutta occupied the time for several months of a clerk, Babu Kanai Lall Das.